Beaufort Sea Play 9: Brookian Unstructured Western Topset

Geological Assessment:

GRASP UAI: AAAAABAO
Play Area: 1950 square miles
Play Water Depth Range: 100 – 1600 feet
Play Depth Range: 2000 – 10000 feet
Play Exploration Chance: 0.3400

Play 9, Brookian Unstructured Western Topset, Beaufort Sea OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas

Assessment Results as of November 2005

Resource Commodity (Units)	Resources *		
	F95	Mean	F05
BOE (Mmboe)	0	475	1,786
Total Gas (Tcfg)	0.000	0.473	1.739
Total Liquids (Mmbo)	0	390	1,477
Free Gas** (Tcfg)	0.000	0.390	1.423
Solution Gas (Tcfg)	0.000	0.082	0.316
Oil (Mmbo)	0	373	1,410
Condensate (Mmbc)	0	17	67

** Risked, Technically-Recoverable*

*** Free Gas Includes Gas Cap and Non-Associated Gas*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Mmb = millions of barrels

Tcf = trillions of cubic feet

Table 1

Play 9, the "Brookian Unstructured Western Topset" play, contains 4% of the Beaufort Sea Province resource endowment (475 Mmbo mean BOE). The overall assessment results for play 9 are shown in table 1. Eighty-two percent of the endowment is likely to be liquid hydrocarbons. Table 5 reports the detailed assessment results by commodity for play 9.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Beaufort Sea play 9. Table 4 reports the risk model used for play 9. The location of play 9 is shown in figure 1.

Play 9 occurs in the Cretaceous deltaic-topset facies of the Brookian sequence, primarily the Nanushuk Group, between the Barrow arch and the hinge-line fault zone to the north. The Nanushuk Group in the play area is likely to be a poor reservoir due to the high clay content of the deltaic sandstones. Potential source beds include the underlying Torok Formation, the Pebble Shale, the Kingak shale and the Shublik Formation. These sources may generate oil and/or gas. The play area is sparsely faulted and the sequence dips homoclinally to the north. Prospects are primarily stratigraphic traps related to reservoir bed pinch-outs. Prospects in this play have not been tested in the offshore. Sub-commercial oil pools onshore with Nanushuk reservoirs include the Simpson (12 MMBO recoverable), Wolf Creek and Fish Creek fields (no resource estimates) in the National Petroleum Reserve-Alaska and Umiat (70 MMBO) (Thomas and others, 1991 Table 2.2).

The primary risk to this play is the presence of adequate reservoir facies due to the Nanushuk's generally poor reservoir parameters. Adequate migration and presence of closure are also risk factors.

A maximum of 14 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 9. These pools range in mean conditional (un-

risked) recoverable volumes from 3.7 Mmboe (pool rank 14) to 423 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 23 Mmboe (F95) to 1490 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 9.

Play 9, Brookian Unstructured Western Topset, Beaufort Sea OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools

Assessment Results as of November 2005

Pool Rank	BOE Resources *		
	F95	Mean	F05
1	23	423	1490
2	7	124	435
3	3	56	183
4	1.9	31	102
5	1.3	20	65
6	0.9	15	47
7	0.7	11	35
8	0.6	9	28
9	0.5	8	23
10	0.4	6	19

** Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Table 2

Table 6 reports statistics for the simulation pools developed in the *GRASP* computer model for play 9. In the computer simulation for the play, a total of 31,810 "simulation pools" were sampled for size. These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Pool size class 11 contains the largest share (5,198, or 16%) of simulation pools (conditional, technically recoverable BOE resources) for play 9. Pool size class 11 ranges from 32 to 64 Mmboe. The largest pool among the 31,810 simulation pools falls within pool size class 18, which ranges in size from 4,096 to 8,192 Mmboe.

GRASP Play Data Form (Minerals Management Service-Alaska Regional Office)

Basin: Beaufort | **Assessor**: Johnson/Scherr | **Date**: 10/14/2005
Play Number: 09 | **Play Name**: Brookian Unstructured Western Topset
Play UAI Number: AAAAABAO

Play Area: mi² (million acres)	1950 (1247.7)	**Play Depth Range**: feet	2000	4,400	10000
Reservoir Thermal Maturity: % Ro		**Expected Oil Gravity**: ° API	25		
		Play Water Depth Range: feet	5	60	800

POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input	38	597		2165	5300		12978			47067		80000	81000
Prospect Area (acres)-Model Output													
Fill Fraction (Fraction of Area Filled)	0.1	0.14		0.29	0.5		0.76			0.95		0.99	1
Productive Area of Pool (acres)	5	212	374	927	2590	7400.925/12928.84	7410	12799	19177	29560			80648
Pay Thickness (feet)	13.0	35.6	42.6	57.4	80.0	90.591/48.523	111.5	133.3	150.4	179.9	220.0	251.6	500.0

MPRO Module (Numbers of Pools)

Play Level Chance	0.8	Prospect Level Chance	0.425	Exploration Chance	0.34

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
	0.8	Presence of Closure	
		Presence of Reservoir Facies	0.5
		Adequate Migration	0.85

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	5.00	5.90	6.40	7.30	8.70	9.36/2.10	10.05	11.00	11.70	12.80	14.00	14.90	15.00
Numbers of Pools in Play			0@F79.22	1	3	3.18/2.24	5	5	6	7	8	8	14

Minimum Number of Pools	0	Mean Number of Pools	3.18	Maximum Number of Pools	14

POOLS/PSRK/PSUM Modules (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	59.0	118.1	133.2	163.0	204.0	215.792/74.926	255.3	287.9	312.3	352.4	403.7	442.0	702.0
Gas Recovery Factor (Mcfg/acre-foot)	173.0	414.7	483.1	623.5	828.0	906.295/406.171	1099.5	1280.2	1419.2	1653.4	1963.5	2202.0	3955.0
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	38.0	96.0	112.9	148.0	200.0	221.428/105.929	270.2	317.6	354.3	416.6	500.0	564.7	1051.0
Condensate Yield ((bbl/Mmcfg)	7.60	19.21	22.58	29.61	40.00	44.286/21.197	54.04	63.51	70.85	83.31	99.98	112.90	210.20

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu)= 10.6631606 σ^2 (sigma squared)= 2.76404946 | **Random Number Generator Seed=** 357315

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.4
Probability Any Pool is 100% Oil	0.5	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.25
Probability Any Pool is 100% Gas	0.1		

Table 3. Input data for Beaufort Sea play 9, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Beaufort	**Play Number, Name:**	09, Brookian Unstructured Western Topset
Assessor(s):	Johnson/Scherr	**Play UAI:**	AAAAABAO
Date:	20-Oct-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

			Play Chance Factors	Averge Conditional Prospect Chance[1]
1.	**Hydrocarbon Fill component** (1a * 1b * 1c)	**1**	***1.0000***	***0.8500***
	a. Presence of a Quality, Effective, Mature Source Rock			
	Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	1.00	1.00
	b. Effective Expulsion and Migration			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	0.85
	c. Preservation			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	1.00
2.	**Reservoir component** (2a * 2b)	**2**	***1.0000***	***0.5000***
	a. Presence of reservoir facies			
	Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	1.00	0.50
	b. Reservoir quality			
	Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	1.00
3.	**Trap component** (3a * 3b)	**3**	***0.8000***	***1.0000***
	a. Presence of trap			
	Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	0.80	1.00
	b. Effective seal mechanism			
	Probability of effective seal mechanism for the trap.	3b	1.00	1.00
Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)			***0.8000***	
	(1 * 2 * 3) *Product of All Subjective Play Chance Factors*			
Average Conditional Prospect Chance[1]				***0.4250***
	(1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*			
	[1] Assumes that the Play exists (where all play chance factors = 1.0)			
	Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide			
Exploration Chance			***0.3400***	
	(Product of Overall Play Chance and Average Conditional Prospect Chance)			

Comments: *See guidance document for explanation of the Risk Analysis Form*

Table 4. Risk model for Beaufort Sea play 9, 2006 assessment.

GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results

Minerals Management Service - Alaska OCS Region
GRASP Model Version: 8.29.2005)
Computes the Geologic Resource Potential of the Play

Play UAI:	**AAAAABAO**		**Play No.**		**9**	
World	Level	-	World	Level	Resources	
Country	Level	-	UNITED	STATES	OF	AMERICA
Region	Level	-	MMS	-	ALASKA	REGION
Basin	Level	-	**BEAUFORT**	**SHELF**		
Play	**Level**	**-**	**Play**		**9**	**Brookian Unstructured**
Geologist	Peter	Johnson				**Western Topset**
Remarks	Play	9	2005	Assessment		
Run Date & Time:		Date	19-Sep-05	Time	13:48:59	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	474,580	668,260
Oil (Mbo)	373,120	559,830
Condensate (Mbc)	17,359	50,722
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	390,410	944,030
Solution Gas (Mmcfg)	82,281	132,970

10000 (Number of Trials in Sample)
0.7919 (MPhc [Probability] of First Occurrence of Non-Zero Resource)
Windowing Feature: used

Empirical Probability Distributions of the Products

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)	Solution Gas (Mmcfg)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	35,564	27,577	1,321	31,284	6,177
70	75,849	57,256	3,328	72,832	12,952
65	113,490	88,316	4,229	98,977	18,748
60	156,000	121,070	5,620	137,540	27,186
55	198,840	157,620	6,694	159,330	34,710
50	246,480	193,410	9,533	203,710	40,997
45	304,260	240,800	11,120	241,780	52,390
40	363,590	280,970	15,333	319,190	58,937
35	436,460	342,950	15,963	357,160	78,672
30	520,280	406,360	18,887	446,630	87,471
25	620,790	500,080	20,093	455,580	109,870
20	756,870	603,470	27,307	578,360	130,290
15	947,570	735,470	33,460	847,720	156,260
10	1,234,600	926,950	52,341	1,233,600	201,120
8	1,400,700	1,172,100	34,915	824,770	263,670
6	1,632,600	1,318,400	51,663	1,178,500	296,840
5	1,786,300	1,409,800	67,134	1,423,000	315,530
4	1,986,100	1,558,900	67,075	1,683,800	339,910
2	2,540,000	2,084,500	74,230	1,680,300	462,640
1	3,133,100	2,421,600	125,970	2,755,000	536,050
0.1	5,357,100	4,754,700	39,609	2,276,100	886,840
0.01	7,916,300	7,650,800	1,732	68,733	1,413,300
0.001	8,351,100	6,810,400	212,070	6,185,700	1,281,500

Table 5. Assessment results by commodity for Beaufort Sea play 9, 2006 assessment.

Basin: BEAUFORT SHELF
Play 09 - Brookian Unstructured Western Topset
UAI Key: AAAAABAO

Model Simulation "Pools" Reported by "Fieldsize.out" *GRASP* Module

Classification and Size				Pool Count Statistics				Pool Types Count			Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range			Pool Resource Statistics (MMBOE)			
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg		Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Total Resource	Average Resource
1	0.0312	0.0625	4	0.012575	0.0004	0.000505		1	1	2	1	1	1	1	1	1	1	1		0.043197	0.062334	0.204511	51.127732
2	0.0625	0.125	25	0.078592	0.0025	0.003157		10	15	0	1	1	1	1	0	0	1	2		0.065167	0.122613	2.322208	92.888303
3	0.125	0.25	62	0.194907	0.0062	0.007828		17	41	4	1	1	1	1	1	1	1	1		0.127434	0.246629	11.906228	192.035928
4	0.25	0.5	154	0.484124	0.0154	0.019444		55	76	23	1	2	1	1	1	1	1	2		0.254192	0.498503	57.928470	376.158893
5	0.5	1	247	0.776485	0.0247	0.031187		93	130	24	1	2	1	1	1	1	1	2		0.501386	0.997665	182.057734	737.075865
6	1	2	624	1.961647	0.0624	0.078788		227	328	69	1	2	1	2	1	2	1	2		1.003385	1.999552	950.108169	1.522609
7	2	4	1252	3.935869	0.1252	0.158081		509	607	136	1	2	1	3	1	2	1	3		2.001824	3.999522	3773.196000	3.013735
8	4	8	2469	7.76171	0.2469	0.311742		950	1244	275	1	3	1	3	1	2	1	4		4.000183	7.999026	14726.870000	5.964711
9	8	16	3922	12.329456	0.3922	0.495202		1561	1963	398	1	3	1	3	1	2	1	5		8.005619	15.998856	46459.286000	11.845815
10	16	32	4906	15.422823	0.4906	0.619444		1949	2406	551	1	4	1	3	1	2	1	4		16.000434	31.998355	114942.865000	23.429039
11	32	64	5198	16.340773	0.5198	0.656313		2048	2652	498	1	3	1	4	1	2	1	5		32.004681	63.999702	240234.321000	46.216682
12	64	128	4696	14.762653	0.4696	0.592929		1921	2330	445	1	4	1	4	1	2	1	4		64.012127	127.917452	429800.413000	91.524788
13	128	256	3631	11.414649	0.3631	0.45846		1408	1856	367	1	3	1	4	1	2	1	4		128.100383	255.924842	656983.443000	180.937332
14	256	512	2451	7.705124	0.2451	0.30947		1012	1211	228	1	3	1	3	1	2	1	4		256.022711	511.762513	879484.159000	358.826660
15	512	1024	1356	4.26281	0.1356	0.171212		574	663	119	1	2	1	2	1	1	1	4		512.120357	1023.928000	956350.428000	705.273193
16	1024	2048	615	1.933354	0.0615	0.077652		244	324	47	1	3	1	2	1	1	1	3		1024.963000	2043.820000	851517.447000	1.384581
17	2048	4096	180	0.56586	0.018	0.022727		60	103	17	1	1	1	2	1	1	1	2		2052.757000	4069.672000	459691.322000	2.553841
18	4096	8192	18	0.056586	0.0018	0.002273		8	9	1	1	1	1	1	1	1	1	1		4153.533000	7505.249000	90664.122000	5.036896
19	8192	16384	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
20	16384	32768	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
21	32768	65536	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
22	65536	131072	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
23	131072	262144	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
24	262144	524288	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
25	524288	1048576	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0									Below Class	0.000000	0.000000	0.000000	0.000000
		Totals	**31810**	**100**	**3.181**	**4.016414**	Above Class	0	0	0									Above Class	0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 7920

Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.

Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.

Table 6. Statistics for simulation pools created in computer sampling run for Beaufort Sea play 9, 2006 assessment.

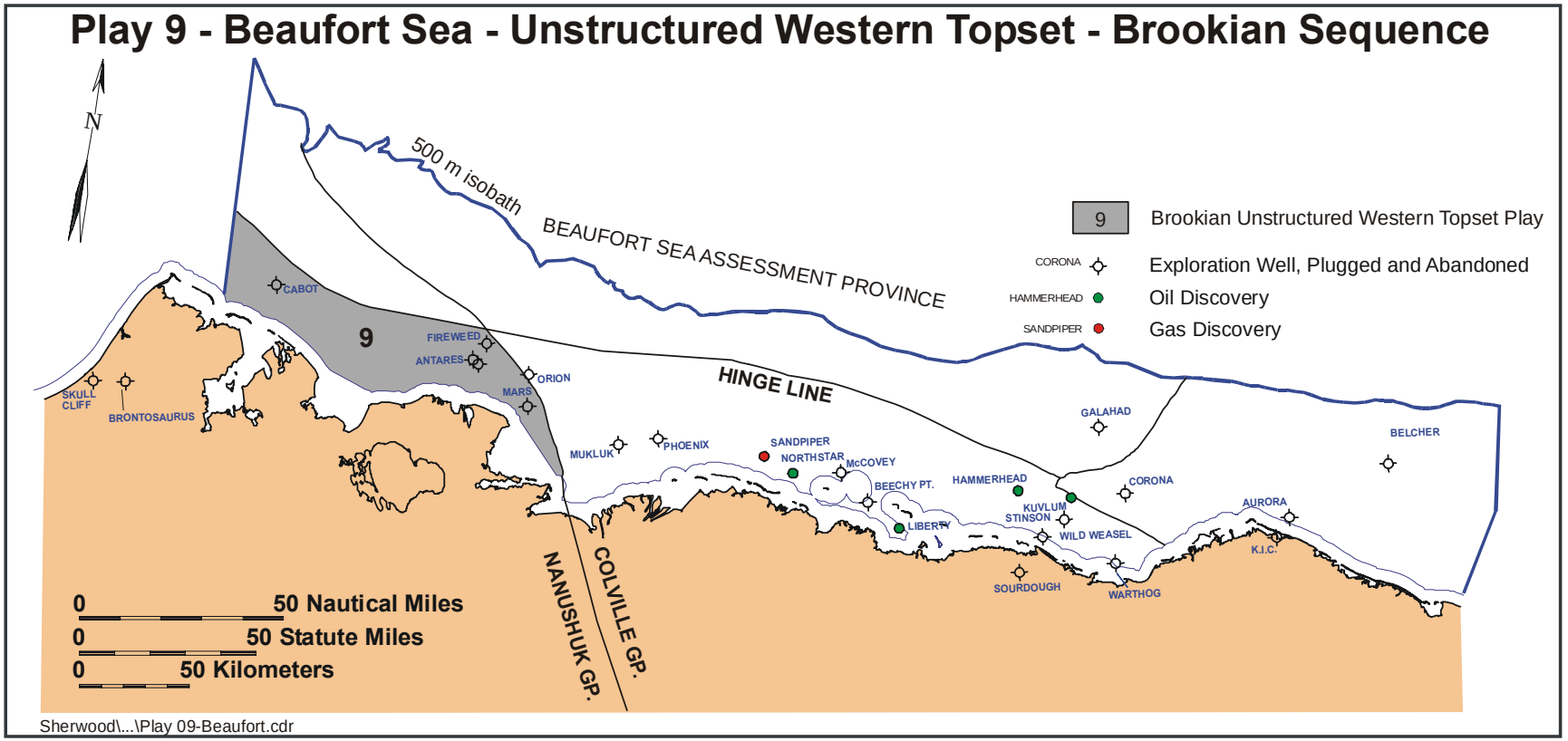

Figure 1. Map location of Beaufort Sea play 9, 2006 assessment.